The Virginia Wetlands Report

Summer 2002
Vol. 17, No. 2

Wetlands Program

Phragmites australis (Reed Grass) Bane or Beneficence?

By Kirk Havens

Phragmites australis, also known as Reed Grass, has received considerable attention in the last decade. Discussion on the value and function of *Phragmites* has resulted in much debate regarding the merits of the plant. Some believe it is the next scourge of the planet - steadily overrunning and devouring other plant communities as it marches across the landscape. Others consider it a beautiful component of the landscape and photograph and paint its feathery plume head as it waves back and forth along the shoreline. In fact, a *Phragmites* patch was a featured photograph recently in Southern Living Magazine. Some people are concerned about its fire risk while others encourage its growth as a privacy fence. Some research has reported it as having only limited value in regard to fish habitat (Hellings and Gallagher 1992; Meyer et al. 2001) while other research suggests that its value to fish is no different than other plants (Warren et al 2001). Most reports agree that it has high value in stabilizing eroding banks and there is general agreement that where it displaces diverse habitats or habitats of threatened or endangered species it is undesirable. It has also become a serious concern in the restoration of wetlands and the construction of compensatory wetland mitigation sites. Resource managers attempting to offset the loss of wetland functions from destruction of natural wetlands due to development activities, often require the construction of new wetlands. *Phragmites* colonization of these constructed sites may result in a net loss of function and a step back from the national policy of "no net loss" of wetlands (Havens et al. 2002).

Phragmites is a cosmopolitan plant found throughout the world. It is an aggressive colonizer of disturbed sites, particularly marsh sites with disrupted hydrology (Chambers et al. 2002), and is rapidly gaining ground in North America displacing species such as *Spartina cynosuriodes*, *Zizania aquatica* and *Spartina patens*. *Phragmites* is considered native to North America and was probably a minor component of the wetland plant community in the past. *P. australis* has been found in archeological sites in the west and peat cores in the east. Stems of *P. australis*, used as cigarettes, were found in Arizona at the Red Bow Cliff Dwellings dating to 1325-1400 A.D. (Adams 1990). *Phragmites* was used in the construction of mats in Anasazi communities in Colorado dating to 880-900 A.D. (Breternitz et al. 1986). In the past *phragmites* had many uses including arrow shafts, food, cigarettes, and thatch for shelter and is still valued in Europe and Asia today.

Phragmites australis*, also known as Reed Grass.*

Phragmites was first recorded in New England in colonial times and its rapid increase in population became a concern with resource managers in Virginia about 40-50 years ago (Silberhorn 1991). The increase in *Phragmites* prompted much discussion regarding the possibility of a recent introduction of a more aggressive, nonnative genotype. Saltonstall (2002) recently reported the existence of native North American *Phragmites* and an introduced European *Phragmites*.

The plant can survive in most wet habitats. Its rapid vegetative propagation and its ability to suppress other plants by shading and litter mat formation (Haslam 1973, Windham and Lathrop 1999) gives *Phragmites* a distinct advantage over other species. A single plant can spread over 1/8 acre in 2 years (Fanshawe 1972). Once established it is extremely difficult to eradicate. The effectiveness of numerous eradication or control methods such as herbicides, flooding, burning, biological control, and discing have been researched in recent times with mixed results (Marks et al. 1994). The most commonly employed and effective control method at present is chemical herbicide treatment used in combination with periodic burning.

The Virginia Wetlands Report is a quarterly publication of the Wetlands Program at the Virginia Institute of Marine Science of the College of William and Mary. Subscriptions are available without charge upon written request to: Wetlands Program, Virginia Institute of Marine Science, P.O. Box 1346, Gloucester Pt, VA 23062 USA. *Address corrections requested.*

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VIMS Publication Center

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This report was funded, in part, by the Virginia Institute of Marine Science and by the Virginia Coastal Resources Management Program of the Department of Environmental Quality through Grant #NA97OZ0181-01 of the National Oceanic and Atmospheric Administration, Office of Ocean and Coastal Resources Management, under the Coastal Zone Management Act, as amended.

The views expressed herein are those of the authors and do not necessarily reflect the views of NOAA or any of its subagencies or DEQ.

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In Europe, deforestation of lakeshore woods in the Bronze Age and Roman period is believed to have promoted expansion of *Phragmites* (Rösch 1987). In more recent times, these areas have been re-colonized by bushes and trees resulting in a reduction of *Phragmites* (Ostendorp 1989). This is encouraging news for those areas where woody species can be allowed to grow. Over time, trees and shrubs will reach heights that will allow them to shade out *Phragmites.*

Concern over the amount of *Phragmites* in the Chesapeake Bay has prompted the states of Virginia, Maryland, and Pennsylvania, the District of Columbia, and the U.S. Environmental Protection Agency to include in the Chesapeake Bay 2000 agreement a provision to identify problem invasive species, and to develop and implement management plans for such organisms. In May of this year, the Chesapeake Bay Program and Maryland Sea Grant convened a workshop to develop regional species management strategies and *Phragmites* was one of the species considered. A draft management plan for *Phragmites australis* is presently being developed.

For more information on *Phragmites*, consider calling the Rappahannock *Phragmites* Action Committee at (804) 443-1118 or visit the following website www.vims.edu/ccrm/phragmites.

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For those daring souls out there, here are a couple of *Phragmites* recipes:

Roasted *Phragmites* Rhizomes
12 *Phragmites* rhizomes (6-8" long)
Wash thoroughly, bake in oven at 350 degree F for 25 - 30 minutes.
Tastes like baked potato jackets.

***Phragmites* Gruel**
1/2 cup seeds of *Phragmites*
2 cups boiling water
Collect a dozen or so seed heads. Remove the seeds and crush. Add to boiling water. Cover and cook slowly until a thin red-colored gruel is formed. Cool and eat. Milk and maple syrup compliment the dish.

Wetland Denizens

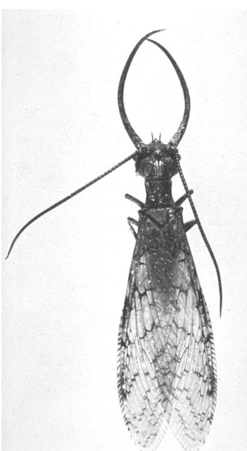
Hellgrammites and Their Relatives

Rebecca Jo Thomas

Ever go fishing using hellgrammites for bait? Hellgrammites, the aquatic larval form of the dobsonfly (*Corydalidae corydalus)*, are most often found under rocks in clean fast-moving streams. Their large size, up to 3.5 inches, and their large pinchers make them interesting to catch and that is why purchasing them at a bait shop can be quite expensive. However, they come highly recommended by trout and bass fishermen alike.

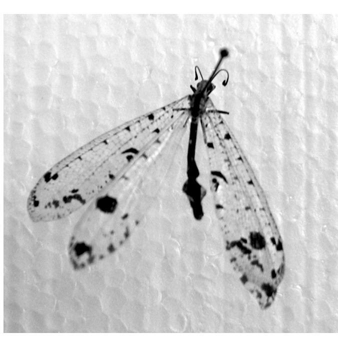
Hellgrammite

Unlike their adult form, which has an average 7 day life span, hellgrammites can live up to 5 years before they crawl out of the water to dig a pupal chamber in the mud. From there they emerge into large flying insects with a 5-inch wingspan. Male dobsonflys have large pincher like mandibles used only for grasping the female during copulation. Once mating has occurred, the females will lay their eggs on rocks or plants that overhang the stream. When they hatch, the larvae fall into the stream to consume small aquatic organisms such as mosquito larva and begin the cycle all over again.



Dobsonfly

A close relative of the dobsonfly is the fishfly (*Corydalidae chauliodes)*. Unlike the hellgrammite, the larva of the fishfly is smaller and prefers the habitat at the bottom of a shallow pond or a pool in a stream, usually under leaf litter, instead of stream riffles. To breath in this environment, the fishfly larva uses respiratory tubes to obtain oxygen from the air in addition to gills. Specimens of this organism have been collected locally, from the Hill Marsh region of the Pamunkey River. This insect experiences the same life cycle as the dobsonfly with the larva living for 2 to 3 years and the adult surviving only a matter of days. The adult, like its offspring, is smaller than the dobsonfly and it does not possess the large mandibles.



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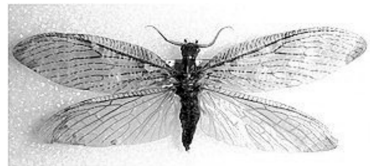


Fishfly

More distant cousins of the dobsonfly include two completely terrestrial insects; the antlion and the lacewing. Adult antlions (*Myrmeleontidae)* are long-winged and slender-bodied, similar to damselflies. They lay their eggs in sand and upon hatching the larva may dig a pit in which it sits and waits for unsuspecting ants (or other insects) to fall into and become food. In some cases, the other insect that falls into the pit is another adult antlion trying to lay its eggs.

Fishfly larvae

All of the adult forms of the insects discussed above are fairly hard to find because they hide under leaves in the day and only fly at night. They are however somewhat attracted to lights at night and this is where the last cousin, the lacewing (*Chrysopidae)*, is most common. These insects are much smaller than the others, reaching about 0.5 inches in length. Their larvae are voracious carnivores and are sometimes called aphid lions because their favorite food is aphids. An individual lacewing larva can eat 25 to 30 aphids a day. These insects are often released in agricultural areas as biological control for aphids.

Lacewing

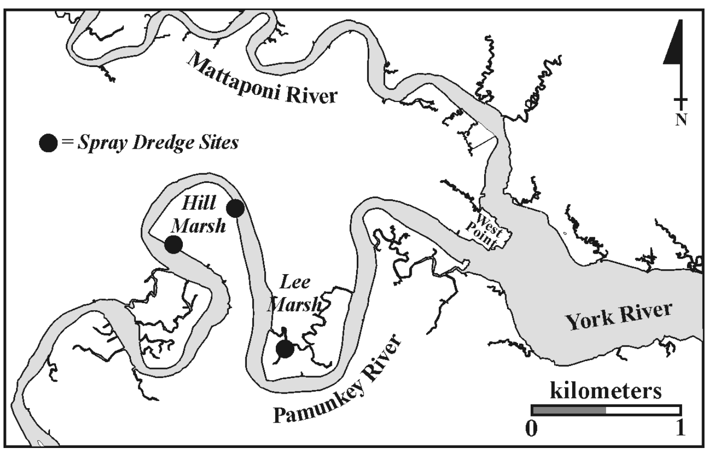
This is one of the traits that group all of these insects together, their desire to prey on other insects. And, it just so happens that the insects they find the tastiest are ones that humans would prefer to do without. The species with aquatic larvae consume mosquitoes, antlions love ants, and lacewings devour aphids. Just one of nature's little perks.

Impacts of Sea Level Rise Studied in Pamunkey River Marshes

Carl Hershner

Virginia's Pamunkey and Mattaponi Rivers are home to some of the largest pristine tidal freshwater marshes in the nation. The largest of these wetlands are found in the bends of the two rivers just upstream of their confluence at West Point. The marshes are highly valued as habitat for waterfowl, fish, and an amazing diversity of plants. The tidal freshwater plant community is among the most productive natural communities known, with plant biomass production equivalent to the most intensive agricultural efforts. The marsh plant communities are also renowned for their aesthetic appeal, with a variety of blooms and seed heads that change with the seasons.

Several years ago, some of the owners of the marshes in the Pamunkey and Mattaponi systems noticed a growing change in the character of the vegetation. Where large stands of giant cordgrass *(Spartina cynosuroides)* used to dominate, arrow arum *(Peltandra virginica)* was now the most common plant. The change was particularly noticeable in the fall when migrating waterfowl moved through the marshes. Where the marsh surface had once been screened by the dead standing stems of giant cordgrass, the marsh now looked like a giant mud flat. Arrow arum leaves nothing above ground when it dies back in the fall.



Location of spray dredge sites on Pamunkey River.

Spray dredging in the Pamunkey River.

Puzzled about the causes and consequences of this change, the marsh owners joined together under the leadership of Sture Olsson to fund the VIMS Wetlands Program to research the issue.

The Wetlands Program scientists hypothesized that rising sea level, potentially combined with local subsidence, was making it impossible for the marshes to accumulate surface material fast enough to precisely maintain their position in the intertidal zone. This would explain the transition from a plant community dominated by giant cordgrass to one dominated by arrow arum.

Researchers had two primary questions:

1. What would be the ecological significance of the change in marsh character?

2. Could anything be done to maintain or restore the original plant community structure?

The resulting project was designed to accomplish several things:

1. Document the differences between giant cordgrass and arrow arum communities;

2. Evaluate several methods of raising the marsh surface incrementally to keep pace with sea level rise; and

3. Assess the potential for unintended expansion of the invasive common reed grass *(Phragmites australis)*.

The research project was designed to last at least four years, and to involve intensive seasonal sampling at multiple sites in Lee and Hill marshes on the Pamunkey River. As part of the experimental design, a small hydraulic dredge specially designed to spray the dredged material was brought to the marshes. Wetlands Program researchers obtained dredging permits in order to conduct three small tests of the impacts of spraying dredged material onto the marsh surface. This is a method that was developed in the Louisiana marshes for disposal of material during maintenance of access channels for oil production facilities. Spray dredging was specifically developed to add thin layers of material to a marsh without destroying existing vegetative communities. The method has not been previously used in the Chesapeake Bay.

In the current project, researchers wanted to determine if spray dredging could be used to raise elevations on the marsh sufficient to reestablish preferred vegetative communities. They also wanted to evaluate the method for broader use as a disposal option for selected dredging projects. A final question was whether elevation increases could be controlled well enough to prevent creation of suitable habitat for *Phragmites.*

The project has been underway for almost two years. Spray dredging was conducted last summer, and both the follow up studies and the basic ecological investigations have been underway since that time. Although all results are

Continued on next page

GIS Geographic Information System

GPS Technology Lends Support to the Marsh Project

Marcia R. Berman and Harry Berquist

You learned about various components of the Marsh Project in Carl Hershner's article on page 4. Global Positioning System (GPS) technology played an important technical role in several project components. This article will summarize a few of them.

The ecology of tidal freshwater marshes like those being studied in the Marsh Project is in part dependent upon the relationship of the surface elevation of the marsh relative to mean sea level. If the marsh surface is unable to keep up with rising sea level the ecology of the marsh will shift towards floral and faunal communities more reflective of shallow open water environments. As noted in the article by Hershner, these marshes are exhibiting signs of change and there is speculation that the marsh is subsiding, or at least unable to keep pace with sea level rise. The project explores the use of a technique known as spray dredging to slowly raise the elevation of the marsh surface with the hope of restoring and maintaining the higher marsh community. This is a technique that has been used in Louisiana marshes undergoing similar environmental stress.

To evaluate the success of the spray dredging very detailed surveys of the marsh surface were required before and after the dredging operation. Since anticipated changes would be very small, a technique that could measure very slight elevation changes over time was required. To accomplish this a GPS survey using dual frequency, carrier phase measurements and Real Time Kinematic (RTK) positioning was employed. Carrier phase measurements provide accuracy at the centimeter level. RTK surveys use a radio link between the base station receiver and the roving receiver so corrections are made as the points are logged in the field. In this project a base station receiver was established near the marsh sites. The rover receiver, or unit on the marshes occupied multiple locations on the marsh surface where the dredge spraying would be deposited as spoil. Approximately 80 points were measured (x,y,z) at each spoil site. The resulting coordinates in the form of a delimited text file were used to generate the marsh surface topography in Erdas Imagine software. Vegetation mapping of invasive species is also a component of the Marsh Project. *Phragmites australis* has colonized these marshes and may be out-competing native species. It is possible to evaluate the rate at which *Phragmites* can spread through these systems by accurately measuring the distribution of the population over time. Over large areas remote sensing techniques are the most desirable option for mapping *Phragmites*. However, this technique requires extensive ground-truth investigations or advanced identification of training samples collected during field visits. The Marsh Project has provided the opportunity to do both. GPS was used to map the distribution of *Phragmites* using Trimble handheld GeoExplorers. The perimeter of *Phragmites* patches was walked and GPS data (x,y) were logged continuously by the field operator. The results provide a baseline from which future measurements at these sites can be compared to determine the rate at which the species is spreading. At the same time, GPS located sites in the field can be combined with orthorectified images of the area to identify the specific signature properties of *Phragmites* patches. Since the vegetation make-up of these patches is known, we can apply the same signature properties [evaluated using image processing software (Erdas)] to other sites.

This study has presented a very exciting opportunity for VIMS-CCRM to combine accepted wetlands field research techniques with the data management benefits of Geographic Information Systems (GIS) and GPS technologies. By combining scientific inquiry and the latest in "high tech" electronic tools, researchers can address more complex questions with greater confidence in their results. We will keep you informed as the study continues through the next two years.

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very preliminary at this time, several observations can already be drawn from the effort.

First, spray dredging appears to be a potentially useful method of dredged material disposal. The initial findings on the three tests plots suggest the marsh vegetation was able to withstand the slurry application, and grow through the accumulated material. An important caveat to this observation, is that the material used in the Pamunkey marsh study was very fine silt and mud. Heavier material such as sand or dense clay may have more significant impacts.

Second, spray dredging using fine silt and mud from marsh creeks is not a particularly effective method of increasing marsh surface elevation. Based on calculations of material accumulation

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-BOOK REVIEW-

Wetlands Explained

By William M. Lewis, Jr.

Review by Walter I. Priest. Jr.

This book could easily be called Wetlands for Dummies. But, actually, it is much more than that. On a sliding scale it lies somewhere between the Corps' 1987 Manual and Mitsch and Gosselink's *Wetlands*. It goes a long way towards explaining many of the intricacies and nuances of wetland identification and delineation.

The author, William M. Lewis, Jr., has unique qualifications for this task. He is Professor and Director of the Center for Limnology at the Cooperative Institute for Research in Environmental Sciences, University of Colorado, Boulder. He has served as a member of the National Research Council's Water Science and Technology Board and as Chair of the NRC Wetlands Characterization Committee and as President of the American Society Of Limnology and Oceanography.

Throughout, the author makes very effective use of analogies to make complex issues more understandable to the average person or less than erudite wetlands scientists. These analogies are very often humorous, but a dry humor that can be as thought provoking and insightful as comical. They also go a long way towards demystifying wetlands regulations and science. The author also avoids jargon wherever possible and relies on common sense lay terminology.

The book begins with a short synopsis of the early wetlands legislation and pretty much how we got to where we are programmatically. I was around for much of what is detailed and it all rings pretty true. It is short and succinct with little embellishment. Included is a discussion of the national policy of "no net loss" which in reality seems to be "slow net loss." It goes on to describe the various definitions of wetlands and how these influenced the development of current regulations. In the next chapter Dr. Lewis provides an insightful discussion on the relationship between wetland functions and values.

The next three chapters each tackle one of the three parameters of wetland delineation; hydrology, soils and vegetation. Again the humorous analogies play an important role as vehicles for the interpretation of the realities of the triumvirate of wetlands. He often uses these to critique critical junctures in wetlands evidence to show the logic or the absence thereof. While spending a considerable amount of time discussing soil saturation, growing season, and soil temperature as they relate to wetland processes, he completely avoids the emerging paradigm that many wetlands, especially in the Southeast, never see temperatures cold enough to shut down biological activities. One might expect the author to at least mention the issue given the copyright year of the book is 2001.

Throughout he argues that the most important, though intractable, parameter is wetland hydrology. Yet, because these data are the hardest to obtain and both hydrophytic vegetation and hydric soils are reflections of the hydrology, he feels that it is acceptable to be able to infer wetlands hydrology from one or both of the other parameters, a la the 1989 Manual. Some will agree with his position. He refers to these as the "pragmatists," those who are more willing to accept realities of life in the real world than the "literalists" who insist on conclusive evidence of all three parameters. This sets a philosophical stage for a debate over the use of "risk analysis" in wetlands delineation. He feels it is better to err on the side of increased inclusiveness that can be adjusted through programmatic amendments as experience dictates. This is a better risk for the resource than the "literalist" approach, which might exclude marginally identifiable areas through rigorous evidentiary requirements. The problem being that it is easier to relinquish authority over non-wetland areas than to recoup the resource lost to the "literalist" approach.

Finally, a parting shot, on page 37 the author unequivocally states, "Water, in the form of particular kinds of hydrologic conditions, is the specific cause of wetlands." Yet on page 132 he states, "there is more than a speck of uncertainty in the notion that wetlands can be replaced functionally, even if the hydrologic conditions for the existence of a wetland are provided with certainty." These statements on their face appear to be contradictory. On the one hand, he states that you cannot have a wetland without water while on the other hand he is stating that, even though you have water, you might not have a wetland after all. Well, to my way of thinking if you have under the right conditions you have or eventually will have a wetland.

In summary, this book is exceptionally well written, eminently readable and technically sound. What makes this book so attractive is the mix of homespun humor and front porch philosophy that the author uses to explain complex and abstract wetlands concepts. Furthermore, it is done in such an engaging manner that one wants to keep reading. I wholeheartedly recommend this book to anyone who thinks they know a lot or would like to know more about wetlands science, policy and politics.

Editor's Note:

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Thank you!

Worldwide Shrimp Farming and Mangrove Wetland Losses: Are the Two Irrevocably Linked?

Pamela Mason

One of the most contentious issues today regarding the use of wetland resources globally, is the conversion of mangroves and other shallow water habitats into ponds for shrimp farming. Historically shrimp farming was very labor intensive and performed on a small scale. However, the ever increasing demand and technological advances in production have resulted in the dramatic conversion of the coastline of much of southeast Asia, parts of Central America and other areas into shrimp farms.

Mangroves are the intertidal wetlands of tropical coastlines. Functioning similarly to Virginia's tidal wetlands, mangroves provide nursery area for coastal fisheries, detritus to support coastal food-webs, protection from coastal erosion and storms, and maintenance of water quality. The mangrove forests support many traditional uses including harvest of fish and wood products. And while the human activities which adversely impact mangroves are not limited to conversion for aquaculture (harvest for wood pulp, and charcoal production being two other common activities), conversion for ponds usually results in a loss of all the natural ecological functions of the mangrove forest.

The conversion of existing, or previously timbered mangroves to shrimp ponds has occurred along the coastlines of many tropical and subtropical nations. The greatest losses have occurred in those nations with the highest shrimp production. Thailand, number one in worldwide production, has lost an estimated 50 percent of its mangroves. Losses in other southeast Asian countries typically exceed 25 percent (The World of Mangroves). Ecuador, the second largest producer of cultured shrimp, lost 162 square miles (20%) during a period of 22 years (Nixon, 1996). Beyond the conversion of coastal habitats into ponds, the intensive shrimp farms tax the assimilation capacity of the remaining mangroves and surrounding coastal waters and require large scale wild fish harvest in order to produce shrimp food.

Crevette

Shrimp pond

The idea of shrimp farming isn't new. Shrimp have been raised in ponds in Southeast Asia for centuries. Fishermen would take advantage of the natural movement of shrimp from open waters to coastal nurseries to capture the shrimp into ponds and hold the shrimp until harvest. Shrimp farms are classified into four categories: traditional, extensive, semi-intensive and intensive, characterized by increasing stocking rates with corresponding feed and water management activities. During the 1970's, the growing availability of seed shrimp and formulated feeds, along with active government and private sector support, prompted the development of intensive shrimp farms. (Primavera, 1994). With the start-up of the large farms, the contribution of cultured shrimp to the total market had risen from about 6% in 1970 to 26% by 1993. In Thailand, cultured shrimp make up about 70 percent of the total production (TED case studies: Thailand shrimp farming)

As a result of the intensive farming practices, individual ponds are short-lived, becoming quickly polluted beyond use, prompting additional clearing for new pond construction. Additionally, the high stocking rates have encouraged the spread of several diseases which have wiped out an entire years production. Both China and Taiwan experienced an almost complete industry collapse in the 1980's and early 1990's.

Many factions, including some progressive shrimp farmers who now recognize the critical role of water quality in sustainable shrimp farming, are

Continued on next page

Calendar of Upcoming Events

October 7-9, 2002	**Wetlands 2002 "Restoring Impaired Wetlands and Other Waters."** Indianapolis, IN. See the Association of State Wetland Managers at www.aswm.org/meeting/2002am.htm
October 22-25, 2002	**Fifth EPA Wetlands Workshop.** Atlantic City, NJ. Contact Ralph Spagnolo at (215) 814-2718 or email spagnolo.ralph@epa..gov
April 13-16, 2003	**Inaugural National Conference on Coastal and Estuarine Habitat Restoration.** Hyatt Regency Inner Harbor. Baltimore, MD. Abstract deadline is 9/13/02. Contact Heather Bradley at (703)524-0248 or email hbradley@estuaries.org
June 8-13, 2003	**Society of Wetland Scientists 24th Annual Meeting**, New Orleans. Changing Landscapes and Interdisciplinary Challenges. Contact Lisa Gandy at (501) 225-1552 or gandylc@swbell.net
July 13-17, 2003	**Coastal Zone 03. Coastal Zone Management Through Time.** Baltimore, MD. Deadline for abstracts is 9/16/02. Contact Jan Kucklick at (843) 740-1279 or email Jan.Kucklick@noaa.gov

Worldwide Shrimp Farming
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looking for solutions to sustainable production. Options range from legislative protections for mangroves, to better management of effluent, to a polyculture of mangroves and shrimp occurring in the same landscape, and other forms of crop rotation. Some efforts are underway to re-forest some of the mangroves, but this process, while promising, is new and untested (Nixon, 1996; Primavera, 1994). If this more balanced approach to shrimp farming takes hold, the practice may continue without the wholesale loss of mangrove wetlands.

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Primavera, J. H. 1994. Shrimp farming in the Asia-Pacific: environmental and trade issues and regional cooperation. Presented at the Nautilus Institute Workshop on trade and Environment in Asia-Pacific: Prospects for Regional Cooperation, September 1994, Honolulu HI. http://www.nautilus.org/papers/enviro/trade/shrimp.html.

TED case studies: Thailand shrimp farming. http://www.american.edu/TED/THAISHMP.HTM

The World of Mangroves: Mangrove-friendly shrimp culture. Http://www.mangroveweb.net/html/mangrov.htm

Spray Dredging
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using high accuracy GPS equipment, the amount of material successfully placed on the marsh surface was very modest, given the amount of material originally excavated. The material available in the marsh creeks is so fine grained, that it does not settle out of the spray runoff on the marsh surface quickly enough to accumulate.

Third, there are some apparent differences between the three marsh communities being intensively studied. Although data is still being collected and analyzed, initial findings suggest that bird and insect communities do vary between arrow arum, giant cordgrass, and *Phragmites*. If continuing work confirms this initial observation, the slow transition from one type of vegetative community to another may indeed portend shifts in the ecological services provided by these systems.

Researchers are currently undertaking a number of new studies, as well as continuing the basic ecological monitoring. This summer another effort will be made to increase elevations on the marsh surface in a number of very small test plots. Methods will include: containment of dredged material in biodegradable containment bags; creation of stilling ponds on the marsh surface using bio-logs (coconut fiber landscaping logs); and addition of wood chip layers to the marsh surface.

None of the methods of increasing marsh elevations is seen as a panacea for the problem of disappearing tidal wetlands. There are simply not enough material or funding to address the entire problem. The current project is moving us closer to understanding the consequences of the ongoing change. It is also arming VIMS scientists with the information necessary to provide sound advice on potential future management options.

Block net used to capture fish moving out of Hill Marsh with the tide